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(71) Applicant:
Chevron Chemical Company LLC
San Francisco, CA 94105 (US)

(72) Inventors:
• **Harrison, James J.**
Novato, California 94947 (US)

• **Ruhe, William R., Jr.**
Benicia, California 94510 (US)

(74) Representative:
Nash, David Allan et al
Haseltine Lake & Co.,
Imperial House, 15-19 Kingsway
London WC2B 6UD (GB)

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(54) **Modified high molecular weight succinimides**

(57) Alkenyl or alkyl succinimide additives which are
the reaction product of a high molecular weight alkenyl-
or alkyl-substituted succinic anhydride and a poly-
alkylene polyamine having an average of greater than 4
nitrogen atoms per mole, wherein the reaction product
is post-treated with a cyclic carbonate, are compatible
with fluorocarbon engine seals and, for concentration
levels at which fluorocarbon seal compatibility is
achieved, possess improved dispersancy and/or deter-
gency properties when employed in lubricating oils and
fuels.

[illegible]

1. The first of these is the fact that the Commission has not yet received any information from the Government of the United Kingdom regarding the proposed changes to the law of the United Kingdom in relation to the treatment of the British Commonwealth countries. This is a matter of great importance to the Commission and it is therefore requested that the Government of the United Kingdom should provide the Commission with the necessary information as soon as possible.

1. The first step in the process of identifying a problem is to define the problem. This involves identifying the symptoms of the problem and determining the scope of the problem. Once the problem has been defined, the next step is to identify the causes of the problem. This involves identifying the factors that are contributing to the problem and determining the underlying causes. Once the causes have been identified, the next step is to develop a plan of action. This involves identifying the steps that need to be taken to solve the problem and determining the resources that will be needed to implement the plan. Once a plan of action has been developed, the next step is to implement the plan. This involves carrying out the steps that have been identified in the plan and monitoring the progress of the implementation. Finally, the last step in the process is to evaluate the results of the implementation. This involves determining whether the problem has been solved and whether the resources have been used effectively.

10-10-70
The following information was obtained from the files of the Federal Bureau of Investigation, Washington, D.C., on the subject of the above captioned matter.

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polybutenes, an especially preferred Mn range is 1700-2400. However, the '435 patent also teaches that the succinimides must have a succinic ratio of at least 1.3, that is at least 1.3 succinic groups per equivalent weight of polyalkene-derived substituent group. Most preferred are succinimides having a succinic ratio of 1.5-2.5. The '435 patent teaches that succinimides must have both a high Mn polyalkylene-derived substituent and a high succinic ratio.

5 The succinimide additives disclosed in the '435 patent are not only dispersants and/or detergents, but also viscosity index improvers. That is, the '435 additives impart fluidity modifying properties to lubricant compositions containing them. However, viscosity index improving properties are not always desirable for the succinimide, as in the case of single-grade oil formulations, for example.

10 Polyamino alkenyl or alkyl succinimides and other additives useful as dispersants and/or detergents, such as Mannich bases, contain basic nitrogen. While basicity is an important property to have in the dispersant/detergent additive, it is believed that the initial attack on fluorocarbon elastomer seals used in some engines involves attack by the basic nitrogen. This attack leads to the loss of fluoride ions, and eventually results in cracks in the seals and loss of other desirable physical properties in the elastomer.

15 One approach towards solving the elastomer problem is described in U.S. Patent No. 4,873,009 to Ronald L. Anderson. This patent is also concerned, in part, with the use of succinimides as lube oil additives. Anderson recognizes in Col. 2, lines 28 et seq. that lube additives prepared from "long chain aliphatic polyamines", i.e., succinimides, "are excellent lube oil additives." Anderson teaches such succinimides are "inferior to additives where the alkylene polyamine is hydroxyalkylated" (Col. 2, lines 31-32). Such hydroxyalkylated polyamine-based succinimides, however, "have the drawback that they tend to attack engine seals particularly those of the fluorocarbon polymer type" (Col. 2, lines 35-37).

20 Anderson solves his fluorocarbon polymer seal compatibility problem by directly borating his hydroxyalkylated polyamine based succinimides. Furthermore, according to Anderson, it would be desirable for the additive to have a relatively high concentration of N-hydroxyalkyl moieties because the more N-hydroxyalkyl substituents, the cleaner the engine. However, Anderson also teaches that the more amino groups in the polyamine, the greater the degradation of fluorocarbon seal, and that alkylene amines containing more than 2 amino groups cannot be utilized (Col. 2, lines 50-62).

Accordingly, there exists a need in the art for a succinimide lubricating oil additive which is effective in controlling engine sludge and varnish, but which does not require boration to achieve fluorocarbon seal compatibility.

30 SUMMARY OF THE INVENTION

A unique class of modified polyamino alkenyl or alkyl succinimide compounds has now been found to be simultaneously compatible with fluorocarbon seals and, at concentration levels for which fluorocarbon seal compatibility is achieved, effective in controlling engine sludge and varnish. These modified polyamino alkenyl or alkyl succinimides are prepared from the succinimide reaction product of 1) an alkenyl- or alkyl-substituted succinic anhydride derived from a polyolefin having a Mn of about 2000 to about 2700 and a weight average molecular weight (Mw) to Mn ratio of about 1 to about 5; and 2) a polyalkylene polyamine having greater than 4 nitrogen atoms per mole. The modified succinimides of the present invention are obtained by post-treating the succinimide reaction product with a cyclic carbonate.

40 Among other factors, the present invention is based on the finding that a unique class of succinimides is effective in controlling engine sludge and varnish at concentration levels for which the succinimides are simultaneously compatible with engine fluorocarbon seals. Generally, known succinimides useful as dispersants and/or detergents are not always compatible with fluorocarbon seals when present in lubricating oil compositions at concentration levels necessary to be effective in controlling engine sludge and varnish. Accordingly, the present invention also relates to a lubricating oil composition containing these modified polyamino alkenyl or alkyl succinimides.

45 Among other factors, the present invention is also based on the finding that a unique class of modified polyamino alkenyl or alkyl succinimides wherein the alkenyl or alkyl substituent has a Mn in the range of 2000-2700 possess both superior fluorocarbon seal compatibility and superior dispersancy and/or detergency properties compared to those wherein the alkenyl or alkyl substituent has a Mn of less than about 2000.

50 In addition to lubricating oil compositions, the present invention also relates to fuel compositions comprising a major portion of a hydrocarbon boiling in a gasoline or diesel range and an amount of a modified polyamino alkenyl or alkyl succinimide, compatible with fluorocarbon seals, sufficient to provide dispersancy and/or detergency.

DETAILED DESCRIPTION OF THE INVENTION

55 The modified polyamino alkenyl or alkyl succinimides of this invention are prepared by post-treating a polyamino alkenyl or alkyl succinimide with a cyclic carbonate. The polyamino alkenyl or alkyl succinimides are typically prepared by reaction of an alkenyl or alkyl succinic anhydride with a polyamine.

Alkenyl or alkyl succinimides are disclosed in numerous references and are well known in the art. Certain funda-

1. The first step is to determine the initial conditions.

2. The second step is to determine the boundary conditions.

3. The third step is to determine the initial and boundary conditions.

4. The fourth step is to determine the initial and boundary conditions.

5. The fifth step is to determine the initial and boundary conditions.

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$$

6. The sixth step is to determine the initial and boundary conditions.

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$$

7. The seventh step is to determine the initial and boundary conditions.

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$$

8. The eighth step is to determine the initial and boundary conditions.

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$$

9. The ninth step is to determine the initial and boundary conditions.

10. The tenth step is to determine the initial and boundary conditions.

11. The eleventh step is to determine the initial and boundary conditions.

12. The twelfth step is to determine the initial and boundary conditions.

13. The thirteenth step is to determine the initial and boundary conditions.

14. The fourteenth step is to determine the initial and boundary conditions.

15. The fifteenth step is to determine the initial and boundary conditions.

M_{po} = number average molecular weight of the starting polyolefin

M_{ma} = 98 (molecular weight of maleic anhydride)

5 C = conversion factor = 112220 (for conversion of gram-moles of alkenyl or alkyl succinic anhydride per gram of sample to milligrams of KOH per gram of sample)

The saponification number, P, can be measured using known procedures, such as the procedure described in ASTM D94.

10 The actives fraction of the alkenyl or alkyl succinic anhydride can be determined from the percent of unreacted polyolefin according to the following procedure. A 5.0 gram sample of the reaction product of maleic anhydride and polyolefin is dissolved in hexane, placed in a column of 80.0 grams of silica gel (Davisil 62, a 140 angstrom pore size silica gel), and eluted with 1 liter of hexane. The percent unreacted polyolefin is determined by removing the hexane solvent under vacuum from the eluent and weighing the residue. Percent unreacted polyolefin is calculated according to the following formula:

$$\text{Percent Unreacted Polyolefin} = \frac{\text{Net Weight of Residue}}{\text{Sample Weight}} \times 100$$

20 The weight percent actives for the alkenyl or alkyl succinic anhydride product is calculated from the percent unreacted polyolefin using the formula:

$$\text{Weight Percent Actives} = 100 - \text{Percent Unreacted Polyolefin}$$

25 The actives fraction of the alkenyl or alkyl succinic anhydride is then calculated as follows:

$$\text{Actives Fraction} = \frac{\text{Weight Percent Actives}}{100}$$

30 The percent conversion of polyolefin is calculated from the weight percent actives as follows:

$$\text{Percent Conversion} = \frac{\text{wt. \% actives} \times \left[\frac{M_{po}}{M_{po} + [M_{ma} \times SR]} \right]}{\left[\text{wt. \% actives} \times \left[\frac{M_{po}}{M_{po} + [M_{ma} \times SR]} \right] \right] + [100 - \text{wt. \% actives}]}$$

40 wherein

M_{po} = number average molecular weight of the starting polyolefin

M_{ma} = 98 (molecular weight of maleic anhydride)

45 SR = succinic ratio of alkenyl or alkyl succinic anhydride product

It is, of course, understood that alkenyl or alkyl succinic anhydride products having high succinic ratios can be blended with other alkenyl succinic anhydrides having lower succinic ratios, for example, ratios of around 1.0, to provide an alkenyl succinic anhydride product having an intermediate succinic ratio.

In general, suitable succinic ratios for the alkenyl or alkyl succinic anhydride reactants employed in preparing the additives of this invention are greater than about 1 but less than about 2. Succinic anhydrides with succinic ratios of about 2, when reacted with amines having greater than 4 nitrogen atoms per mole and post-treated with a cyclic carbonate, form gels. Accordingly, succinic ratios of about 1.7 or less are preferred.

55 The Polyamino Reactant

The polyamine to be reacted with the alkenyl or alkyl succinic anhydride in order to produce the polyamino alkenyl

The first step in the synthesis of the polymer is the reaction of the monomer with the initiator to form the active species.

The second step is the propagation of the active species to form the polymer chain.

The third step is the termination of the polymer chain.

The fourth step is the transfer of the polymer chain to a new active species.

The fifth step is the termination of the polymer chain to form the final product.

The sixth step is the termination of the polymer chain to form the final product.

The seventh step is the termination of the polymer chain to form the final product.

The eighth step is the termination of the polymer chain to form the final product.

The ninth step is the termination of the polymer chain to form the final product.

The tenth step is the termination of the polymer chain to form the final product.

The eleventh step is the termination of the polymer chain to form the final product.

The twelfth step is the termination of the polymer chain to form the final product.

The thirteenth step is the termination of the polymer chain to form the final product.

The fourteenth step is the termination of the polymer chain to form the final product.

The fifteenth step is the termination of the polymer chain to form the final product.

The sixteenth step is the termination of the polymer chain to form the final product.

The seventeenth step is the termination of the polymer chain to form the final product.

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the number of moles of polyamine to the number of moles of succinic groups in the succinic anhydride reactant. The number of moles of succinic groups in the succinic anhydride reactant is determined as follows:

$$\text{number of moles of succinic groups} = \frac{P}{C} \times \text{weight of alkenyl or alkyl succinic anhydride sample (g)}$$

wherein P and C are as defined above.

POST-TREATMENT OF THE POLYAMINO ALKENYL OR ALKYL SUCCINIMIDE WITH A CYCLIC CARBONATE

The polyamino alkenyl or alkyl succinimides formed as described above are then reacted with a cyclic carbonate. The resulting modified polyamino alkenyl succinimide has one or more nitrogens of the polyamino moiety substituted with a hydroxy hydrocarbyl oxycarbonyl, a hydroxy poly(oxyalkylene) oxycarbonyl, a hydroxyalkylene, hydroxy-alkylenepoly(oxyalkylene), or mixture thereof. The products so produced are compatible with fluorocarbon seals and are effective dispersant and detergent additives for lubricating oils and for fuels.

The reaction of a polyamino alkenyl or alkyl succinimide with a cyclic carbonate is conducted at a temperature sufficient to cause reaction of the cyclic carbonate with the polyamino alkenyl or alkyl succinimide. In particular, reaction temperatures of from about 0°C to about 250°C are preferred with temperatures of from about 100°C to 200°C being more preferred and temperatures of from 150°C to 180°C are most preferred.

The reaction may be conducted neat, wherein both the alkenyl or alkyl succinimide and the cyclic carbonate are combined in the proper ratio, either alone or in the presence of a catalyst (such as an acidic, basic or Lewis acid catalyst), and then stirred at the reaction temperature. Examples of suitable catalysts include, for instance, phosphoric acid, boron trifluoride, alkyl or aryl sulfonic acid, alkali or alkaline carbonate.

Alternatively, the reaction may be conducted in a diluent. For example, the reactants may be combined in a solvent such as toluene, xylene, oil or the like, and then stirred at the reaction temperature. After reaction completion, volatile components may be stripped off. When a diluent is employed, it is preferably inert to the reactants and products formed and is generally used in an amount sufficient to insure efficient stirring.

Water, which can be present in the polyamino alkenyl or alkyl succinimide, may be removed from the reaction system either before or during the course of the reaction via azeotroping or distillation. After reaction completion, the system can be stripped at elevated temperatures (100°C to 250°C) and reduced pressures to remove any volatile components which may be present in the product.

Alternatively, a continuous system may be employed in which the alkenyl or alkyl succinic anhydride and polyamine are added at the front end of the system while the organic carbonate is added further downstream in the system. In such a continuous system, the organic carbonate may be added at any time after mixing of the alkenyl or alkyl succinic anhydride with the polyamine has occurred. Preferably, the organic carbonate is added within two hours after mixing of the alkenyl or alkyl succinic anhydride with the polyamine, preferably after the major portion of the amine has reacted with the anhydride.

In a continuous system, the reaction temperature may be adjusted to maximize reaction efficiency. Accordingly, the temperature employed in the reaction of the alkenyl or alkyl succinic anhydride with a polyamine may be the same as or different from that which is maintained for the reaction of this resulting product with the cyclic carbonate. In such a continuous system, the reaction temperature is generally between 0°C to 250°C; preferably between 125°C to 200°C; and most preferably between 150°C to 180°C.

The reaction of polyamino alkenyl or alkyl succinimides with cyclic carbonates is known in the art and is described in U.S. Patent 4,612,132, which is totally incorporated herein by reference.

A particularly preferred cyclic carbonate is 1,3-dioxolan-2-one (ethylene carbonate). Ethylene carbonate is commercially available or may be prepared by methods well-known in the art.

The molar charge of cyclic carbonate employed in the post-treatment reaction is based upon the theoretical number of basic nitrogens contained in the polyamino substituent of the succinimide. Thus, when 1 equivalent of tetraethylene pentamine ("TEPA") is reacted with two equivalents of succinic anhydride, the resulting bis succinimide will theoretically contain 3 basic nitrogens. Accordingly, a molar charge of 2 would require that two moles of cyclic carbonate be added for each basic nitrogen or in this case 6 moles of cyclic carbonate for each mole of bis succinimide prepared from TEPA. Mole ratios of the cyclic carbonate to the basic amine nitrogen of the polyamino alkenyl succinimide employed in the process of this invention are generally in the range of from about 1.5:1 to about 4:1; although preferably from about 2:1 to about 3:1.

As described in U.S. Patent No. 4,612,132, cyclic carbonates may react with the primary and secondary amines of a polyamino alkenyl or alkyl succinimide to form two types of compounds. In the first instance, strong bases, including unhindered amines such as primary amines and some secondary amines, react with an equivalent of cyclic carbonate to produce a carbamic ester. In the second instance, hindered bases, such as hindered secondary amines, may react with an equivalent of the same cyclic carbonate to form a hydroxyalkyleneamine linkage. Unlike the carbamate prod-

in the base fuel is 10 to 10,000 weight parts per million, preferably from 30 to 2,000 weight parts per million, of the modified succinimide per part of base fuel. If other detergents are present, a lesser amount of the modified succinimide may be used.

The modified succinimide additives of this invention may also be formulated as a fuel concentrate, using an inert stable oleophilic organic solvent boiling in the range of about 150°F to 400°F. Preferably, an aliphatic or an aromatic hydrocarbon solvent is used, such as benzene, toluene, xylene or higher-boiling aromatics or aromatic thinners. Aliphatic alcohols of about 3 to 8 carbon atoms, such as isopropanol, isobutylcarbinol, n-butanol and the like, in combination with hydrocarbon solvents are also suitable for use with the fuel additive. In the fuel concentrate, the amount of the additive will be ordinarily at least 10 percent by weight and generally not exceed 70 percent by weight and preferably from 10 to 25 weight percent (all on a dry polymer basis).

The following examples are offered to specifically illustrate this invention. These examples and illustrations are not to be construed in any way as limiting the scope of this invention.

EXAMPLES

Example 1. Preparation of PIBSA 2200 (succinic ratio = 1.1)

A 35.186 Kg, 16 mol., sample of Parapol 2200 (a 2200 Mn polybutene available from Exxon Chemical Company) was charged to a reactor and heated to 232°C. During this time, the reactor was pressurized to 40 psig with nitrogen and then vented three times to remove oxygen. The reactor was pressurized to 24.7 psia. Then 1500 g maleic anhydride was added over a thirty-minute period. Then 4581 g maleic anhydride was added over a 4-hour period. The total charge mole ratio (CMR) of maleic anhydride to polybutene was 3.88. After the maleic anhydride addition was completed, the reaction was held at 232°C for 1.5 hour. Then the reaction was cooled and the pressure reduced to 0.4 psia to remove any unreacted maleic anhydride. To this was then added a light neutral diluent oil. This was heated to 160°C for 24 hours and was then filtered. This product was found to contain 37.68 wt. % actives and had a saponification number of 19.7 mg KOH/g sample. The succinic ratio was 1.1 based on a polybutene molecular weight of 2246 determined by GPC.

Example 2. Preparation of PIBSA 1300 (succinic ratio = 1.1)

The procedure of Example 1 was repeated except that Parapol 1300 (a 1300 Mn polybutene available from Exxon Chemical Company) was used instead of Parapol 2200. After dilution with diluent oil and filtration, this product was found to contain 49.6 wt. % actives and a saponification number of 42.2 mg KOH/g sample. The succinic ratio was 1.1 based on a polybutene molecular weight of 1300.

Example 3. Preparation of PIBSA 2200 (succinic ratio = 1.5)

Parapol 2200, 42.8 Kg, 19.45 mol, was charged to a reactor and the temperature was increased to 150°C. During this time, the reactor was pressurized to 40 psig with nitrogen and then vented three times to remove oxygen. Then at 150°C, maleic anhydride, 4294 g, 43.82 mol, and di-t-butylperoxide, 523 g, 3.58 mol, was added. The first 25% was added over 30 minutes. The remainder was then added over 11.5 hours. The CMR of maleic anhydride to polybutene was 2.25. The reaction was held at 150°C for one hour. Then the reactor was heated to 190°C for 1 hour to destroy any remaining di-t-butylperoxide. Then vacuum was applied to the reactor and the unreacted maleic anhydride was removed. This material was then diluted with a light neutral oil and filtered. The product after filtration had a saponification number of 31.6 mg KOH/g sample and contained 45.62 wt. % actives. The succinic ratio was 1.5 for this material based on a polybutene molecular weight of 2200.

Example 4A. Preparation of PIBSA 1300 (succinic ratio = 1.9)

Parapol 1300, 6.9 Kg, 47.6 mol, was charged to a reactor and the temperature was increased to 150°C. During this time, the reactor was pressurized to 40 psig with nitrogen and then vented three times to remove oxygen. Then at 150°C, maleic anhydride, 9332.66 g (95.23 mol), and di-t-butylperoxide, 1280 g (8.77 mol) was added over 5 hours. Then the reaction was maintained at 150°C for an additional 2 hours. The reaction was then heated to 190°C for 1 hour to destroy any residual peroxide. The pressure was then reduced to 0.4 psia and the excess maleic anhydride was removed. The product was found to contain 65.4 wt. % actives and had a saponification number of 94.5 mg KOH/g sample. The succinic ratio was 1.9 for this material based on a polybutene molecular weight of 1300.

TABLE I

(Analytical Data For Examples 5-19)					
Compound of Example No.:	DESCRIPTION	MEASURED			
		%N	TBN	VIS 100 (cSt)	SpGr (15°C)
5	bis HPA-X PIBSA 2200 (SR=1.1; A/P=0.44)	0.74	17	428	0.9106
6	bis TETA PIBSA 1300 (SR=1.1; A/P=0.5)	0.99	15	278	0.9300
7	bis HPA-X PIBSA 2200 (SR=1.5; A/P=0.5)	1.05	25	1688	0.9219
8	bis HPA-X PIBSA 1300 (SR=1.1; A/P=0.5)	1.55	36	272	0.9214
9	bis TETA PIBSA 2200 (SR=1.5; A/P=0.5)	0.64	10	1554	0.9339
10	bis TETA PIBSA 2200 (SR=1.1; A/P=0.44)	0.41	5	491	0.9093
11	EC bis HPA-X PIBSA 1300 (SR=1.1; A/P=0.5; EC/BN=2.0)	1.51	20	447	0.9393
12	EC bis TETA PIBSA 1300 (SR=1.5; A/P=0.5; EC/BN=2.0)	0.96	8	305	0.9282
13	bis TETA PIBSA 1300 (SR=1.5; A/P=0.5)	0.87	15	145	0.9120
14	bis HPA-X PIBSA 1300 (SR=1.5; A/P=0.5)	1.52	37	165	0.9142
15	EC bis TETA PIBSA 1300 (SR=1.5; A/P=0.5; EC/BN=2.0)	0.99	11	136	0.9156
16	EC bis HPA-X PIBSA 1300 (SR=1.5; A/P=0.5; EC/BN=2.0)	1.46	19	402	0.9330
17	EC bis HPA-X PIBSA 2200 (SR=1.1; A/P=0.44; EC/BN=2.0)	0.63	9	660	0.9188
18	EC bis HPA-X/DETA PIBSA 2200 (SR=1.1; A/P=0.40; EC/BN=2.4)	0.44	6	485	0.9132
19	EC bis HPA-X/DETA PIBSA 1300 (SR=1.1; A/P=0.5; EC/BN=2.0)	1.18	9.7	287	
Note: SR = succinic ratio A/P = amine/PIBSA CMR EC/BN = ethylene carbonate/basic nitrogen CMR					

Blending of Samples on an Equal Basis

We chose to blend and test the additives in Examples 5-19 on an equal wt. % actives basis. This was because we were trying to compare products from four different PIBSA's with different molecular weights and different succinic ratios, and two different amines with and without ethylene carbonate treatment. In order to do this, we calculated the %N and TBN that was expected for these compounds from the molecular formulas for a product that contained 40 wt. % actives. These data are reported in Table II. The succinimides from Examples 5-18 were then blended into the finished oil for testing at a concentration of 7.5% of the 40 wt. % actives material or at 3% on a dry polymer basis. The amounts of succinimides were adjusted to take into account the differences between the %N of the particular batch and the %N expected for the example. For Example 19, a 5% blend of 50 wt. % actives material or 3% on a dry polymer basis was made.

Date		Time		Location	
1	100	100	100	100	100
2	100	100	100	100	100
3	100	100	100	100	100
4	100	100	100	100	100
5	100	100	100	100	100
6	100	100	100	100	100
7	100	100	100	100	100
8	100	100	100	100	100
9	100	100	100	100	100
10	100	100	100	100	100
11	100	100	100	100	100
12	100	100	100	100	100
13	100	100	100	100	100
14	100	100	100	100	100
15	100	100	100	100	100
16	100	100	100	100	100
17	100	100	100	100	100
18	100	100	100	100	100
19	100	100	100	100	100
20	100	100	100	100	100
21	100	100	100	100	100
22	100	100	100	100	100
23	100	100	100	100	100
24	100	100	100	100	100
25	100	100	100	100	100
26	100	100	100	100	100
27	100	100	100	100	100
28	100	100	100	100	100
29	100	100	100	100	100
30	100	100	100	100	100
31	100	100	100	100	100
32	100	100	100	100	100
33	100	100	100	100	100
34	100	100	100	100	100
35	100	100	100	100	100
36	100	100	100	100	100
37	100	100	100	100	100
38	100	100	100	100	100
39	100	100	100	100	100
40	100	100	100	100	100
41	100	100	100	100	100
42	100	100	100	100	100
43	100	100	100	100	100
44	100	100	100	100	100
45	100	100	100	100	100
46	100	100	100	100	100
47	100	100	100	100	100
48	100	100	100	100	100
49	100	100	100	100	100
50	100	100	100	100	100
51	100	100	100	100	100
52	100	100	100	100	100
53	100	100	100	100	100
54	100	100	100	100	100
55	100	100	100	100	100
56	100	100	100	100	100
57	100	100	100	100	100
58	100	100	100	100	100
59	100	100	100	100	100
60	100	100	100	100	100
61	100	100	100	100	100
62	100	100	100	100	100
63	100	100	100	100	100
64	100	100	100	100	100
65	100	100	100	100	100
66	100	100	100	100	100
67	100	100	100	100	100
68	100	100	100	100	100
69	100	100	100	100	100
70	100	100	100	100	100
71	100	100	100	100	100
72	100	100	100	100	100
73	100	100	100	100	100
74	100	100	100	100	100
75	100	100	100	100	100
76	100	100	100	100	100
77	100	100	100	100	100
78	100	100	100	100	100
79	100	100	100	100	100
80	100	100	100	100	100
81	100	100	100	100	100
82	100	100	100	100	100
83	100	100	100	100	100
84	100	100	100	100	100
85	100	100	100	100	100
86	100	100	100	100	100
87	100	100	100	100	100
88	100	100	100	100	100
89	100	100	100	100	100
90	100	100	100	100	100
91	100	100	100	100	100
92	100	100	100	100	100
93	100	100	100	100	100
94	100	100	100	100	100
95	100	100	100	100	100
96	100	100	100	100	100
97	100	100	100	100	100
98	100	100	100	100	100
99	100	100	100	100	100
100	100	100	100	100	100

The following table shows the results of the survey conducted on the 10th of the month. The data is presented in a tabular format, with the first column representing the date, the second column representing the time, and the third column representing the location. The fourth column represents the results of the survey, which are presented in a numerical format. The data is presented for the first 100 days of the month, with the results of the survey being presented in a numerical format. The data is presented for the first 100 days of the month, with the results of the survey being presented in a numerical format.

TABLE III - (PV-3344 TEST RESULTS)

Additive Compound of Example No.	Concentration of Additive (Wt. %)	TS (Pass \geq 8.0)	EL (Pass \geq 160)	CR (Pass = N)
5	1.6	10.0	203	N
	2.0	9.4	189	N
	2.4	8.8	196	N
	2.4	8.0	175	Y
	2.8	7.8	176	Y
	3.2	7.2	167	Y
6	1.6	10.8	218	N
	2.4	9.6	197	N
7	1.6	10.9	220	N
8	1.6	6.5	155	Y
	2.4	6.0	146	Y
9	1.6	11.7	232	N
10	1.6	12.5	244	N
	3.2	11.7	240	N
11	1.6	6.0	139	Y
	2.8	5.8	141	Y
12	1.6	10.9	216	N
13	1.6	11.2	224	N
	2.4	9.4	196	N
14	1.6	6.9	160	Y
	2.4	5.6	137	Y
15	1.6	11.7	233	N
	2.4	10.7	207	N
16	1.6	6.8	153	Y
	2.4	6.4	148	Y
17	1.6	9.0	188	N
	2.0	8.8	180	N
	2.4	8.8	196	N
	2.8	7.5	172	Y
	3.2	7.9	169	Y
18	1.6	12.1	238	N
	2.0	11.6	233	N
	2.4	11.1	220	N
	2.8	10.7	220	N
	3.2	10.0	206	N
19	1.6	10.1	186	N
	2.8	8.3	150	Y

The detergency properties of the additive compounds were then tested using the Sequence VE engine test procedure, as defined in ASTM Proposed Method:212. This test measures, among other things, average engine sludge (AES) and average engine varnish (AEV). The AES and AEV results for the compounds of Examples 5-19 are shown in Table IV. A dosage or treat rate level of 3.0% (on a dry polymer basis) was chosen as an appropriate concentration level for the Seq. VE test since treat rate levels exceeding 3% are generally too high for the resulting additive package to be priced competitively in the marketplace. Examples 17 and 18 were each run at concentration levels of 2.0 and 1.5% (on a dry polymer basis).

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The following information was obtained from the above mentioned sources:

BOSCO M. GONZALEZ

1. 1

STATION DATA							
STATION	DATE	TIME	TYPE	REMARKS	REMARKS	REMARKS	REMARKS
1	10	10	10	10	10	10	10
2	11	11	11	11	11	11	11
3	12	12	12	12	12	12	12
4	13	13	13	13	13	13	13
5	14	14	14	14	14	14	14
6	15	15	15	15	15	15	15
7	16	16	16	16	16	16	16
8	17	17	17	17	17	17	17
9	18	18	18	18	18	18	18
10	19	19	19	19	19	19	19
11	20	20	20	20	20	20	20
12	21	21	21	21	21	21	21
13	22	22	22	22	22	22	22
14	23	23	23	23	23	23	23
15	24	24	24	24	24	24	24
16	25	25	25	25	25	25	25
17	26	26	26	26	26	26	26
18	27	27	27	27	27	27	27
19	28	28	28	28	28	28	28
20	29	29	29	29	29	29	29
21	30	30	30	30	30	30	30
22	31	31	31	31	31	31	31
23	32	32	32	32	32	32	32
24	33	33	33	33	33	33	33
25	34	34	34	34	34	34	34
26	35	35	35	35	35	35	35
27	36	36	36	36	36	36	36
28	37	37	37	37	37	37	37
29	38	38	38	38	38	38	38
30	39	39	39	39	39	39	39
31	40	40	40	40	40	40	40
32	41	41	41	41	41	41	41
33	42	42	42	42	42	42	42
34	43	43	43	43	43	43	43
35	44	44	44	44	44	44	44
36	45	45	45	45	45	45	45
37	46	46	46	46	46	46	46
38	47	47	47	47	47	47	47
39	48	48	48	48	48	48	48
40	49	49	49	49	49	49	49
41	50	50	50	50	50	50	50
42	51	51	51	51	51	51	51
43	52	52	52	52	52	52	52
44	53	53	53	53	53	53	53
45	54	54	54	54	54	54	54
46	55	55	55	55	55	55	55
47	56	56	56	56	56	56	56
48	57	57	57	57	57	57	57
49	58	58	58	58	58	58	58
50	59	59	59	59	59	59	59
51	60	60	60	60	60	60	60
52	61	61	61	61	61	61	61
53	62	62	62	62	62	62	62
54	63	63	63	63	63	63	63
55	64	64	64	64	64	64	64
56	65	65	65	65	65	65	65
57	66	66	66	66	66	66	66
58	67	67	67	67	67	67	67
59	68	68	68	68	68	68	68
60	69	69	69	69	69	69	69
61	70	70	70	70	70	70	70
62	71	71	71	71	71	71	71
63	72	72	72	72	72	72	72
64	73	73	73	73	73	73	73
65	74	74	74	74	74	74	74
66	75	75	75	75	75	75	75
67	76	76	76	76	76	76	76
68	77	77	77	77	77	77	77
69	78	78	78	78	78	78	78
70	79	79	79	79	79	79	79
71	80	80	80	80	80	80	80
72	81	81	81	81	81	81	81
73	82	82	82	82	82	82	82
74	83	83	83	83	83	83	83
75	84	84	84	84	84	84	84
76	85	85	85	85	85	85	85
77	86	86	86	86	86	86	86
78	87	87	87	87	87	87	87
79	88	88	88	88	88	88	88
80	89	89	89	89	89	89	89
81	90	90	90	90	90	90	90
82	91	91	91	91	91	91	91
83	92	92	92	92	92	92	92
84	93	93	93	93	93	93	93
85	94	94	94	94	94	94	94
86	95	95	95	95	95	95	95
87	96	96	96	96	96	96	96
88	97	97	97	97	97	97	97
89	98	98	98	98	98	98	98
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91	100	100	100	100	100	100	100
92	101	101	101	101	101	101	101
93	102	102	102	102	102	102	102
94	103	103	103	103	103	103	103
95	104	104	104	104	104	104	104
96	105	105	105	105	105	105	105
97	106	106	106	106	106	106	106
98	107	107	107	107	107	107	107
99	108	108	108	108	108	108	108
100	109	109	109	109	109	109	109
101	110	110	110	110	110	110	110
102	111	111	111	111	111	111	111
103	112	112	112	112	112	112	112
104	113	113	113	113	113	113	113
105	114	114	114	114	114	114	114
106	115	115	115	115	115	115	115
107	116	116	116	116	116	116	116
108	117	117	117	117	117	117	117
109	118	118	118	118	118	118	118
110	119	119	119	119	119	119	119
111	120	120	120	120	120	120	120
112	121	121	121	121	121	121	121
113	122	122	122	122	122	122	122
114	123	123	123	123	123	123	123
115	124	124	124	124	124	124	124
116	125	125	125	125	125	125	125
117	126	126	126	126	126	126	126
118	127	127	127	127	127	127	127
119	128	128	128	128	128	128	128
120	129	129	129	129	129	129	129
121	130	130	130	130	130	130	130
122	131	131	131	131	131	131	131
123	132	132	132	132	132	132	132
124	133	133	133	133	133	133	133
125	134	134	134	134	134	134	134
126	135	135	135	135	135	135	135
127	136	136	136	136	136	136	136
128	137	137	137	137	137	137	137
129	138	138	138	138	138	138	138
130	139	139	139	139	139	139	139
131	140	140	140	140	140	140	140
132	141	141	141	141	141	141	141
133	142	142	142	142	142	142	142
134	143	143	143	143	143	143	143
135	144	144	144	144	144	144	144
136	145	145	145	145	145	145	145
137	146	146	146	146	146	146	146
138	147	147	147	147	147	147	147
139	148	148	148	148	148	148	148
140	149	149	149	149	149	149	149
141	150	150	150	150	150	150	150
142	151	151	151	151	151	151	151
143	152	152	152	152	152	152	152
144	153	153	153	153	153	153	153
145	154	154	154	154	154	154	154
146	155	155	155	155	155	155	155
147	156	156	156	156	156	156	156
148	157	157	157	157	157	157	157
149	158	158	158	158	158	158	158
150	159	159	159	159	159	159	159
151	160	160	160	160	160	160	160
152	161	161	161	161	161	161	161
153	162	162	162	162	162	162	162
154	163	163	163	163	163	163	163
155	164	164	164	164	164	164	164
156	165	165	165	165	165	165	165
157	166	166	166	166	166	166	166
158	167	167	167	167	167	167	167
159	168	168	168	168	168	168	168
160	169	169	169	169	169	169	169
161	170	170	170	170	170	170	170
162	171	171	171	171	171	171	171
163	172	172	172	172	172	172	172
164	173	173	173	173	173	173	173
165	174	174	174	174	174	174	174
166	175	175	175	175	175	175	175
167	176	176	176	176	176	176	176
168	177	177	177	177	177	177	177
169	178	178	178	178	178	178	178
170	179	179	179	179	179	179	179
171	180	180	180	180	180	180	180
172	181	181	181	181	181	181	181
173	182	182	182	182	182	182	182
174	183	183	183	183	183	183	183
175	184	184	184	184	184	184	184
176	185	185	185	185	185	185	185
177	186	186	186	186	186	186	186
178	187	187	187	187	187	187	187
179	188	188	188	188	188	188	188
180	189	189	189	189	189	189	189
181	190	190	190	190	190	190	190
182	191	191	191	191	191	191	191
183	192	192	192	192	192	192	192
184	193	193	193	193	193	193	193
185	194	194	194	194	194	194	194
186	195	195	195	195	195	195	195
187	196	196	196	196	196	196	196
188	197	197	197	197	197	197	197
189	198	198	198	198	198	198	198
190	199	199	199	199	199	199	199
191	200	200	200	200	200	200	200
192	201	201	201	201	201	201</	

TABLE V (continued)

(EFFECT OF POLYBUTENE Mn)							
Compound of Example No.:	Succinic Ratio	Amine Type	Ethylene Carb nate P st- Treat- ment	Poly- butene Mn	PV-3344 TS	Seq. VE AES	Seq. VE AEV
8	1.1	HPA-X	No	1300	6.5	7.7	4.6
5	1.1	HPA-X	No	2200	10.0	9.4	5.6
11	1.1	HPA-X	Yes	1300	6.0	9.1	5.9
17	1.1	HPA-X	Yes	2200	9.0	9.4	5.9
14	1.5	HPA-X	No	1300	6.9	9.3	5.4
7	1.5	HPA-X	No	2200	10.9	9.5	6.0
13	1.5	TETA	No	1300	11.2	9.1	5.1
9	1.5	TETA	No	2200	11.7	9.3	5.6
Average	-	-	-	1300	8.3	8.6	4.9
Average	-	-	-	2200	10.8	9.3	5.4

Table V demonstrates that a polyisobutene Mn of 2200 gives better PV-3344 and better Seq. VE results than a polyisobutene Mn of 1300.

TABLE VI

(EFFECT OF AMINE TYPE)							
Compound of Example No.:	Poly- butene Mn	Suc- cinic Ratio	Ethylene Carbonate Post- Treat- ment	Amine Type	PV-3344 TS	Seq. VE AES	Seq. VE AEV
6	1300	1.1	No	TETA	10.8	8.0	3.4
8	1300	1.1	No	HPA-X	6.5	7.7	4.6
10	2200	1.1	No	TETA	12.5	8.9	4.0
5	2200	1.1	No	HPA-X	10.0	9.4	5.6
9	2200	1.5	No	TETA	11.7	9.3	5.6
7	2200	1.5	No	HPA-X	10.9	9.5	6.0
12	1300	1.1	Yes	TETA	10.9	8.7	4.1
11	1300	1.1	Yes	HPA-X	6.0	9.1	5.9
13	1300	1.5	No	TETA	11.2	9.1	5.1
14	1300	1.5	No	HPA-X	6.9	9.3	5.4
15	1300	1.5	Yes	TETA	11.7	9.4	5.3
16	1300	1.5	Yes	HPA-X	6.8	9.4	6.4
Average	-	-	-	TETA	11.5	8.9	4.6
Average	-	-	-	HPA-X	7.9	9.1	5.6
17	2200	1.1	Yes	HPA-X	9.0	9.4	5.9

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[illegible]

1. The first group of species, the "true" *Staphylinidae*, are characterized by the presence of a pair of long, slender, and often curved antennae. These species are typically found in the soil and are known for their ability to burrow. They are often found in large numbers in the soil of forests and fields.

[illegible][illegible]

1. The first step in the process of identifying a problem is to determine the nature of the problem. This involves a thorough understanding of the situation and the factors that are contributing to the problem. Once the nature of the problem is understood, the next step is to identify the causes of the problem. This involves a detailed analysis of the situation and the factors that are contributing to the problem. Once the causes of the problem are identified, the next step is to develop a plan of action. This involves determining the steps that need to be taken to solve the problem. Once a plan of action is developed, the next step is to implement the plan. This involves taking the steps that have been determined in the plan of action and putting them into practice. Once the plan has been implemented, the next step is to evaluate the results. This involves determining whether the problem has been solved and whether the plan of action was effective. If the problem has not been solved, the process starts over with the first step.

1. 1950-1951: The first year of the program was marked by a high degree of uncertainty and a lack of clear direction. The program was established in 1950, but the initial focus and goals were not clearly defined. The program was initially intended to be a broad-based program, but it quickly became clear that the program was intended to be a program of research and development in the field of nuclear energy. The program was intended to be a program of research and development in the field of nuclear energy, and it was intended to be a program of research and development in the field of nuclear energy.

[illegible]

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TABLE VIII

(CONCLUSIONS)			
	Better PV-3344 Performance	Better Seq. VE (AES) Performance	Better Seq. VE (AEV) Performance
5 A. Polyisobutene Mn (1300 or (2200)	2200	2200	2200
10 B. Post-Treatment (Yes or No) with ethylene carbonate	No (slightly)	Yes	Yes
C. Amine type			
15 1. TETA or HPA-X	TETA	HPA-X (slightly)	HPA-X
2. HPA or DETA/HPA-X	DETA/HPA-X	HPA-X (slightly)	HPA-X

Table VIII shows that the most desirable additives contain a 2200 Mn substituent, are derived from a polyamine having greater than 4 nitrogen atoms per mole, and are post-treated with ethylene carbonate.

While TETA appears to be the best amine type for PV-3344 performance, the concentration levels required for this amine type to achieve suitable Seq. VE performance (AEV results in particular) are unacceptable because they are too high to allow for a competitive treat rate. Accordingly, the amine should have greater than 4 nitrogen atoms per mole.

For multi-grade oil applications, the succinimide additive may be derived from a succinic anhydride having a succinic ratio of approximately 1.5. However, the viscosity index improvement which accompanies succinimides having succinic ratios of about 1.3 or greater is not always desirable. Instead, for some applications, such as single-grade oil formulation, a succinic ratio less than about 1.3, preferably closer to 1, is more desirable. Furthermore, Example 20 (made from the PIBSA of Example 4A) shows that succinic ratios of about 1.9 are unacceptable because gels are formed. Accordingly, succinic ratios greater than 1 but less than about 2 are acceptable, with succinic ratios less than about 1.7 preferred.

Succinimide additives having a 2200 Mn alkenyl or alkyl group which are derived from an amine having greater than 4 nitrogen atoms per mole, and which are post-treated with ethylene carbonate, are compatible with fluorocarbon seals at concentration levels for which they are excellent detergent additives. Such additive compounds (Examples 17 and 18) pass the Seq. VE test at low concentration levels and are desirable because less of the additive is needed in additive packages, thereby resulting in lower-cost oil formulations.

Claims

1. A lubricating oil composition comprising a major amount of an oil of lubricating viscosity and an effective amount of a modified polyamino alkenyl or alkyl succinimide sufficient to be compatible with fluorocarbon seals and simultaneously control engine sludge and varnish, wherein the modified succinimide comprises the succinimide reaction product of:
 - (i) an alkenyl- or alkyl-substituted succinic anhydride derived from a polyolefin having a Mn of about 2000 to about 2700 and a Mw/Mn ratio of about 1 to about 5; and
 - (ii) a polyalkylene polyamine having greater than 4 nitrogen atoms per mole;
 wherein the succinimide reaction product is post-treated with a cyclic carbonate.
2. A lubricating oil composition according to Claim 1 wherein the charge mole ratio of (ii) to (i) is from about 0.35:1 to about 0.6:1; and the charge mole ratio of cyclic carbonate to basic amine nitrogen in the succinimide reaction product is from about 1.5:1 to about 4:1.
3. A lubricating oil composition according to Claim 1 wherein the polyolefin has a Mn of about 2100 to about 2400.
4. A lubricating oil composition according to Claim 3 wherein the polyolefin has a Mn of about 2200.
5. A lubricating oil composition according to Claim 1 wherein the polyolefin is polybutene.

1. The first group of respondents (n = 10) was asked to identify the most important factors influencing their decision to use a mobile app. The results showed that the most important factors were the app's functionality, ease of use, and security.

[illegible]

4. Since the 1970s, the FBI has been able to identify and locate the subjects of the 100 most wanted list. In 1970, the FBI had 100 most wanted subjects, but by 1975, it had 1,000. By 1980, it had 1,500. By 1985, it had 2,000. By 1990, it had 2,500. By 1995, it had 3,000. By 2000, it had 3,500. By 2005, it had 4,000. By 2010, it had 4,500. By 2015, it had 5,000. By 2020, it had 5,500. By 2025, it had 6,000. By 2030, it had 6,500. By 2035, it had 7,000. By 2040, it had 7,500. By 2045, it had 8,000. By 2050, it had 8,500. By 2055, it had 9,000. By 2060, it had 9,500. By 2065, it had 10,000. By 2070, it had 10,500. By 2075, it had 11,000. By 2080, it had 11,500. By 2085, it had 12,000. By 2090, it had 12,500. By 2095, it had 13,000. By 2100, it had 13,500. By 2105, it had 14,000. By 2110, it had 14,500. By 2115, it had 15,000. By 2120, it had 15,500. By 2125, it had 16,000. By 2130, it had 16,500. By 2135, it had 17,000. By 2140, it had 17,500. By 2145, it had 18,000. By 2150, it had 18,500. By 2155, it had 19,000. By 2160, it had 19,500. By 2165, it had 20,000. By 2170, it had 20,500. By 2175, it had 21,000. By 2180, it had 21,500. By 2185, it had 22,000. By 2190, it had 22,500. By 2195, it had 23,000. By 2200, it had 23,500. By 2205, it had 24,000. By 2210, it had 24,500. By 2215, it had 25,000. By 2220, it had 25,500. By 2225, it had 26,000. By 2230, it had 26,500. By 2235, it had 27,000. By 2240, it had 27,500. By 2245, it had 28,000. By 2250, it had 28,500. By 2255, it had 29,000. By 2260, it had 29,500. By 2265, it had 30,000. By 2270, it had 30,500. By 2275, it had 31,000. By 2280, it had 31,500. By 2285, it had 32,000. By 2290, it had 32,500. By 2295, it had 33,000. By 2300, it had 33,500. By 2305, it had 34,000. By 2310, it had 34,500. By 2315, it had 35,000. By 2320, it had 35,500. By 2325, it had 36,000. By 2330, it had 36,500. By 2335, it had 37,000. By 2340, it had 37,500. By 2345, it had 38,000. By 2350, it had 38,500. By 2355, it had 39,000. By 2360, it had 39,500. By 2365, it had 40,000. By 2370, it had 40,500. By 2375, it had 41,000. By 2380, it had 41,500. By 2385, it had 42,000. By 2390, it had 42,500. By 2395, it had 43,000. By 2400, it had 43,500. By 2405, it had 44,000. By 2410, it had 44,500. By 2415, it had 45,000. By 2420, it had 45,500. By 2425, it had 46,000. By 2430, it had 46,500. By 2435, it had 47,000. By 2440, it had 47,500. By 2445, it had 48,000. By 2450, it had 48,500. By 2455, it had 49,000. By 2460, it had 49,500. By 2465, it had 50,000. By 2470, it had 50,500. By 2475, it had 51,000. By 2480, it had 51,500. By 2485, it had 52,000. By 2490, it had 52,500. By 2495, it had 53,000. By 2500, it had 53,500. By 2505, it had 54,000. By 2510, it had 54,500. By 2515, it had 55,000. By 2520, it had 55,500. By 2525, it had 56,000. By 2530, it had 56,500. By 2535, it had 57,000. By 2540, it had 57,500. By 2545, it had 58,000. By 2550, it had 58,500. By 2555, it had 59,000. By 2560, it had 59,500. By 2565, it had 60,000. By 2570, it had 60,500. By 2575, it had 61,000. By 2580, it had 61,500. By 2585, it had 62,000. By 2590, it had 62,500. By 2595, it had 63,000. By 2600, it had 63,500. By 2605, it had 64,000. By 2610, it had 64,500. By 2615, it had 65,000. By 2620, it had 65,500. By 2625, it had 66,000. By 2630, it had 66,500. By 2635, it had 67,000. By 2640, it had 67,500. By 2645, it had 68,000. By 2650, it had 68,500. By 2655, it had 69,000. By 2660, it had 69,500. By 2665, it had 70,000. By 2670, it had 70,500. By 2675, it had 71,000. By 2680, it had 71,500. By 2685, it had 72,000. By 2690, it had 72,500. By 2695, it had 73,000. By 2700, it had 73,500. By 2705, it had 74,000. By 2710, it had 74,500. By 2715, it had 75,000. By 2720, it had 75,500. By 2725, it had 76,000. By 2730, it had 76,500. By 2735, it had 77,000. By 2740, it had 77,500. By 2745, it had 78,000. By 2750, it had 78,500. By 2755, it had 79,000. By 2760, it had 79,500. By 2765, it had 80,000. By 2770, it had 80,500. By 2775, it had 81,000. By 2780, it had 81,500. By 2785, it had 82,000. By 2790, it had 82,500. By 2795, it had 83,000. By 2800, it had 83,500. By 2805, it had 84,000. By 2810, it had 84,500. By 2815, it had 85,000. By 2820, it had 85,500. By 2825, it had 86,000. By 2830, it had 86,500. By 2835, it had 87,000. By 2840, it had 87,500. By 2845, it had 88,000. By 2850, it had 88,500. By 2855, it had 89,000. By 2860, it had 89,500. By 2865, it had 90,000. By 2870, it had 90,500. By 2875, it had 91,000. By 2880, it had 91,500. By 2885, it had 92,000. By 2890, it had 92,500. By 2895, it had 93,000. By 2900, it had 93,500. By 2905, it had 94,000. By 2910, it had 94,500. By 2915, it had 95,000. By 2920, it had 95,500. By 2925, it had 96,000. By 2930, it had 96,500. By 2935, it had 97,000. By 2940, it had 97,500. By 2945, it had 98,000. By 2950, it had 98,500. By 2955, it had 99,000. By 2960, it had 99,500. By 2965, it had 100,000. By 2970, it had 100,500. By 2975, it had 101,000. By 2980, it had 101,500. By 2985, it had 102,000. By 2990, it had 102,500. By 2995, it had 103,000. By 3000, it had 103,500. By 3005, it had 104,000. By 3010, it had 104,500. By 3015, it had 105,000. By 3020, it had 105,500. By 3025, it had 106,000. By 3030, it had 106,500. By 3035, it had 107,000. By 3040, it had 107,500. By 3045, it had 108,000. By 3050, it had 108,500. By 3055, it had 109,000. By 3060, it had 109,500. By 3065, it had 110,000. By 3070, it had 110,500. By 3075, it had 111,000. By 3080, it had 111,500. By 3085, it had 112,000. By 3090, it had 112,500. By 3095, it had 113,000. By 3100, it had 113,500. By 3105, it had 114,000. By 3110, it had 114,500. By 3115, it had 115,000. By 3120, it had 115,500. By 3125, it had 116,000. By 3130, it had 116,500. By 3135, it had 117,000. By 3140, it had 117,500. By 3145, it had 118,000. By 3150, it had 118,500. By 3155, it had 1

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1. The first part of the report, which is the most important, is the one that deals with the results of the investigation. This part should be written in a clear and concise manner, and should be supported by evidence. The second part of the report is the one that deals with the conclusions of the investigation. This part should be written in a clear and concise manner, and should be supported by evidence. The third part of the report is the one that deals with the recommendations of the investigation. This part should be written in a clear and concise manner, and should be supported by evidence.

[illegible]

cyclic carbonate is ethylene carbonate, and the charge mole ratio of cyclic carbonate to basic amine nitrogen in the succinimide reaction product is from about 2:1 to about 3:1.

- 5 21. A lubricating oil concentrate according to Claim 19 wherein the polyolefin is polyisobutene having a Mn of about 2200, the succinic anhydride has a succinic ratio from about 1 to about 1.7, the polyalkylene polyamine comprises 20% by weight diethylene triamine and 80% by weight Union Carbide HPA-X heavy polyamine, the charge mole ratio of (ii) to (i) is from about 0.4:1 to about 0.5:1, the cyclic carbonate is ethylene carbonate, and the charge mole ratio of cyclic carbonate to basic amine nitrogen in the succinimide reaction product is from about 2:1 to about 3:1.
- 10 22. A fuel composition comprising a hydrocarbon boiling in the gasoline or diesel range and from about 10 to about 10,000 weight parts per million on a dry polymer basis of a modified polyamino alkenyl or alkyl succinimide comprising the succinimide reaction product of:
- 15 (i) an alkenyl- or alkyl-substituted succinic anhydride derived from a polyolefin having a Mn of about 2000 to about 2700 and a Mw/Mn ratio of about 1 to about 5; and
(ii) a polyalkylene polyamine having greater than 4 nitrogen atoms per mole;
wherein the succinimide reaction product is post-treated with a cyclic carbonate.
- 20 23. A fuel concentrate comprising an inert stable oleophilic organic solvent boiling in the range of 150°F to 400°F and from about 10 to about 70 weight percent on a dry polymer basis of a modified polyamino alkenyl or alkyl succinimide comprising the succinimide reaction product of:
- 25 (i) an alkenyl- or alkyl-substituted succinic anhydride derived from a polyolefin having a Mn of about 2000 to about 2700 and a Mw/Mn ratio of about 1 to about 5; and
(ii) a polyalkylene polyamine having greater than 4 nitrogen atoms per mole;
wherein the succinimide reaction product is post-treated with a cyclic carbonate.
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